DOCUMENT RESUME

ED 247 714 EC 170 069

AUTHOR Morariu, Janis; Bruning, Roger
TITLE A Contextualist Perspective of Language Processing by Prelingually Deaf Students.
PUB DATE Jun 84
NOTE 20p.; Contained in: International Symposium on Cognition, Education, and Deafness (Washington, DC, June 5-8, 1984). Working Papers. Volumes I and II. David S. Martin, Ed.
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Bilingual Education; Congenital Impairments; *Deafness; Encoding (Psychology); *English Instruction; High Schools; *Language Acquisition; *Language Skills; Recall (Psychology); *Sign Language; Syntax

ABSTRACT

The problem of English language-processing by 30 prelingually deaf high school students is examined from a contextualist perspective. The influence of language mode (print or sign) and syntax--English or American Sign Language (ASL) on recall, preference, and comprehension was approached through the processing of meaningful and coherent passages of similar content, length, and syntactic complexity. It was hypothesized that the four language contexts (signed ASL, signed English, print ASL, print English) would produce differential effects on the encoding and retrieval of the propositions embedded within the passages. Results showed greater propositional recall from ASL than from English for all language contexts. The study demonstrates both that the syntax component of language context plays a major role in facilitating access to meaning, and that implications exist for a bilingual approach to language acquisition with ASL as the primary vehicle for the development of English proficiency. (Author/CL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED247714

A CONTEXTUALIST PERSPECTIVE OF LANGUAGE PROCESSING BY PRELINGUALLY DEAF STUDENTS

Janis Morariu
University of Maryland

and

Roger Bruning
University of Nebraska

Abstract

The problem of English language-processing by prelingually deaf high school students is examined from a Contextualist Perspective. The influence of language mode (print or sign) and syntax (English or American Sign Language [ASL]) on recall, preference, and comprehension was approached through the processing of meaningful and coherent passages of similar content, length, and syntactic complexity. It was hypothesized that the four language contexts (signed ASL, signed English, print ASL, print English) would produce differential effects on the encoding and retrieval of the propositions embedded within the passages. Results showed greater propositional recall from ASL than from English for all language contexts. This study demonstrates both that the syntax component of language context plays a major role in facilitating access to meaning, and that implications exist for a bilingual approach to language acquisition with ASL as the primary vehicle for the development of English proficiency.

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Janice Morariu

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

EC 170069

Rationale and Literature Review

The problem of teaching reading to prelingually deaf children rests in deciding how best to establish effective English decoding skills within their development of information-processing capabilities. The deaf child's lack of auditory input has been hypothesized to lead to the development of a visual information encoding system that is vastly different from that developed among normal-hearing individuals (Goldin-Meadow & Mylander, 1983; Kretschmer & Kretschmer, 1978). Previous research has indicated that deaf individuals who use sign language tend to encode printed information visually, while hearing individuals process such material auditorially (Conrad, 1972; Frumkin & Anisfeld, 1977; Hanson, 1982; Locke & Locke, 1971; MacDougall, 1979; Shand, 1982; Treiman & Hirsh-Pasek, 1983; Wallace & Corballis, 1973). Visual processing among deaf individuals, however, has been defined and examined through two distinct perspectives. one focusing on print configurations and the other focusing on manually-coded letters and words, as in fingerspelling and American Sign Language. In both kinds of studies, hearing subjects experience more confusions in recognition between print letters or words that are acoustically similar, suggesting that for hearing subjects, print material is transformed into a verbal code for processing. Although there is some evidence that certain profoundly deaf individuals use a verbal code in memory tasks (Conrad, 1972; Hanson, 1982; Locke & Locke, 1971), the majority of encoding studies suggest that the encoding and retrieval of information from a print medium for deaf individuals may actually be a multiple-step process in which, first, they transform a typically verbal code (print English) into a visual mode (sign language) for processing, and second, they must recode the stored visual code back into a verbal code in order to communicate in what is

normally a spoken language system (Bellugi, Klima, & Siple, 1975; Frumkin & Anisfeld, 1977; Hanson, 1982; Shand, 1982; Treiman & Hirsh-Pasek, 1983).

In an attempt to utilize the sign-based encoding orientation of deaf children to facilitate English language acquisition, many educational programs for deaf learners adopt a system of signed English in which signs are borrowed and modified from American Sign Language (ASL) while the syntax of English is held intact (Fant, 1972; Kretschmer & Kretschmer, 1978). Although signed English appears to be similar to ASL in the sense that both systems share much of their sign-vocabulary, they are actually two distinct language systems. ASL is a visual/conceptual language system, whereas English is based on an auditory/temporal orientation (Bellugi & Klima, 1975; Kretschmer & Kretschmer, 1978). Where signed English adheres to the grammar and syntax of spoken and printed English, ASL is a "spatial language in motion" (Hoemann, 1975, viii) in which variations in movement, position, handshape, and facial expression indicate grammatical relationships (Fant, 1972; Hoemann, 1975).

In spite of the fact that most deaf children are taught only English in school, most are likely to use a form of signed ASL as adults (Fant, 1972; Hoemann, 1975; Kretschmer & Kretschmer, 1978). The acquisition of signed ASL for many deaf individuals occurs through an informal, and often sporadic, exposure to other deaf youngsters and/or adults using ASL (Fant, 1972; Kretschmer & Kretschmer, 1978). One may question at this point why, through informal exposure, almost all prelingually deaf individuals who have been formally taught in a system of signed and written standard English would adopt a signed language so radically different from English as their primary language. Perhaps visual/conceptual languages such as ASL are better suited than English to deaf individuals' information-processing capabilities.

The evidence thus far suggests that the total language encounter will exert a significant influence on an individual's processing of a language experience. For deaf individuals the language encounter may include any combination of a printed or signed mode of presented information in either English or ASL syntax. The experiment to be reported is an attempt to examine the influence of language mode (sign vs. print) and language syntax (English vs. ASL) on propositional encoding and recall among prelingually deaf subjects. The theory, methodology, and analysis of this often elusive question of how information is processed by deaf subjects is examined here from a contextualist perspective of information-processing.

As early as the 1940's, the contextualist view was beginning to take a key position in the science of psychology (Pepper, 1942). Contextualism takes into account not only the actions of an individual but the total context within which an individual functions. Jenkins (1974) defines contextualism in the following way:

> Contextualism holds that experience consists of events. Events have a quality as a whole. By quality is meant the total meaning of the event. The quality of the event is the resultant of the interaction of the experiencer and the world, that is, the interaction of the organism and the physical relations that provide support for the experience. The relations can be thought of and analyzed into textures. A texture in turn consists of strands lying in a context. (p. 786)

The present experiment considers the contextual effects involved when deaf individuals derive meaning either from watching a signed passage or from reading printed passages. In the contextual view the total meaning of each passage will

lie in the quality of the passage event in the context of the message encounter. The contextualist would argue that because the focus is on the quality of the message, attention will be focused on its texture, consisting of the words or signs and grammatical relations between them in the particular context, whether it be signed English, signed ASL, print English, or print ASL (ASL is not typically recognized as a print language). As Hanson (1982) suggests, when deaf individuals encounter a signed message, it may call into operation the conceptual/spatial orientation associated with the processing of ASL, while an encounter with a printed message may trigger the sequential and temporal orientation of English language processing. It is the "subject's orientation toward comprehension" in any language encounter that "changes the nature of what was remembered in such a way as to produce radical changes in recall and recognition" (Jenkins, 1974, 787).

In a contextualist study of word recognition and recall, Watkins and Tulving (1975) found that subjects often failed to recognize a single word from a previously learned list even though they could recall the word if asked to recall the entire original list. They argued that it is within the context of the entire list that each word is recalled; however, outside of the word-list context, each individual word is less likely to be recognized. At least for simple materials, context determines the nature of the encoding and hence its probability of being retrieved from memory.

A study by Siple, Fischer, and Bellugi (1977) that explored the processing and retrieval by deaf subjects of information encountered from a combined list of ASL signs and English words in print, demonstrates similar context effects. ASL signs and English words were selected from a pool of common items that are easily translated from English to ASL. Original presentation versus test presentation modes were equally divided between the conditions: Sign-Sign, Sign-Word, Word-Sign, and Word-Word. A spoken word-printed word format videotape of the same

initial list presented to the deaf groups was presented to hearing subjects as a basis for a comparison of information processing in memory. Half of the subjects in each group (hearing versus deaf) were instructed to remember the language (or modality) of the initially presented items, while the remainder of the subjects were uninstructed with respect to language or modality.

Overall, the results indicated that correct modality judgments were made more frequently when the original input and the test modality were identical (i.e., sign-sign, word-word). For deaf subjects signs were recognized correctly more often than words. The data also indicated that signs from ASL were treated like lexical items from any other language system rather than as alternate presentations of English words. Likewise, English words in print were not encoded as alternate presentations of ASL signs. Siple, et al. (1977) concluded that "ASL signs are preserved in memory on the basis of semantic organization when they have meaning within a language context, much as English words are" (p. 571), and they speculated that language information and modality information are stored in memory differently.

Pearson and Johnson (1978) assert that most meaningful language processing is derived from encounters with coherent language passages rather than with a series of lexical units. Although the Siple, et al. (1977) study points strongly to contextual effects in recall, it has little to say about whether such effects will be present in the processing of discourse when subjects encounter passages that contain meaningful propositions. The present experiment examines the effects of context in this latter setting, as subjects were presented with passages in a variety of mode and syntactical formats.

Although ASL is typically not a language that is communicated through print, much of the grammar and syntax of ASL can be conveyed through print using English words (Fant, 1972; Hoemann, 1975). Hoemann (1975), for example, presented printed

English passages with ASL translations in print as part of the lexical and grammatical exercises used to teach ASL to hearing individuals. Because a study comparing the processing of a printed ASL equivalent to an English narrative has not appeared in the literature, an initial study by Morariu and Bruning (1982) examined how deaf and hearing subjects would respond to ASL in print. Based on studies that have shown that printed information is recoded by many deaf individuals into a sign-based code (e.g., Frumkin & Anisfeld, 1977; Treiman & Hirsh-Pasek, 1983), this initial study predicted that deaf students would find the printed ASL passages to be more compatible with their visual information-encoding system, thus allowing them to access the meaning more directly because less attention would be focused on decoding at the syntactic level (LaBerge & Samuels, 1976). Also, deaf subjects should prefer the ASL passages and rate them easier to read then English passages. By contrast, hearing subjects would be expected to encode the English versions of the passages with greater ease, thereby recalling more from the English passages than from the ASL passages. This ease of processing should have also led the hearing subjects to rate the English passages as both preferable and easier to read.

Results for hearing subjects in the initial study supported an interpretation that effort toward comprehension plays a major role in their recall since they required more reading time of ASL passages and recalled more propositions from ASL than from the English passages. Deaf subjects, however, exhibited no significant difference either in the propositions recalled or in reading times for the ASL and English passages, indicating a familiarity with ASL that was not exhibited by the hearing group. Even though there was no significant difference between the groups on their readability ratings of the English passages, deaf subjects rated the ASL passages higher than did the hearing subjects. This rating difference provides support for the assertion that the deaf subjects, regardless of their

lack of formal instruction in ASL, subjectively experienced less confusion (or more familiarity) with ASL syntax than did the hearing subjects.

Although the results of the Morariu and Bruning (1982) study did not support the prediction that for deaf subjects a context consisting of ASL syntax in print would facilitate the cognitive processing of propositions embedded in text, the results provide support for the hypothesis that ASL syntax is familiar to the prelingually deaf subjects, even when presented in a print mode. Based on the preferred language used by deaf adults, irrespective of whether they are native users of ASL, the most readily assimilated language from signing should be ASL. Thus, the language-processing methods utilized by deaf individuals may be more meaningfully inferred from a contextual perspective by examining: (a) the effect of the two most prevalent modes of language experience, signing and print; and (b) the two most commonly encountered forms of language syntax, English and ASL.

The following four language contexts were hypothesized to produce different influences on deaf individuals' encoding and retrieval of meaningful propositions embedded within coherent messages:

1. Signed ASL incorporates movement for maximum input and a conceptually-oriented language system (ASL) that capitalizes on spatial relationships and movement variations to produce grammatical patterns.

2. Signed English includes movement for visual input and a temporally-oriented language system (English) that systematically incorporates the grammatical structures of spoken or written English (the dominant language of a hearing society) within a signed system adapted from ASL.

3. Print English combines minimally useful visual input from variations in graphic symbols with the syntax of English.

4. Print ASL incorporates minimally useful visual input from variations of the graphic symbols used in English and an adaptation of signed ASL grammatical structures.

Hypotheses

The combination of each familiar syntax with its most commonly encountered mode of presentation produces the two language contexts of interest, signed ASL and print English. Based on results of the Morariu and Bruning (1982) study, the contextualist theory of the importance of the total language context in language processing, and the predominant language used by deaf adults, it was hypothesized that an interaction would occur between the mode and syntax components such that signed ASL would yield greater recall than print English. It was also hypothesized that the ease of processing signed ASL would override any bias toward English and that the subjects would rate the signed ASL as more highly preferable and understandable than either the signed or print English. As a typically unencountered language context, print ASL was predicted to yield the least recall and the lowest readability and preference ratings. The predicted order of significance for the recall of propositions, the readability ratings, and the preference ratings for the four contexts was: signed ASL > print English > signed English > print ASL.

Method

Subjects. A sample of 30 prelingually deaf high school students between the ages of 15 and 19 years served as the subjects. Subjects were selected from three midwestern residential schools for the deaf based on a minimum reading level of at least a 3.0 grade equivalent and average intelligence. Each subject had a measured severe-to-profound hearing loss (at least 80 dB), with the onset of deafness occurring from birth to three years (mode = 0 years).

Materials. Twelve passages developed from the Morariu and Bruning (1982) study served as the basis for the present study. Each passage described how an individual was given a particular nickname and consisted of six to eight sentences, with an average of 15 propositions (Bower, 1976) per paragraph,

irrespective of the passage version. The passages were presented in either English or ASL syntax, and in either print or a signed mode.

For both the print and sign mode, the subjects first encountered an English version of one of the passages, followed by alternating ASL and English versions of the five other passages in the set. The print passages were presented separately within a loose-leaf notebook, while the signed passages were presented on videotape by a skilled signer signing both the ASL and English passages.

In a study of deaf signers' code-switching ability, Robert Hoffmeister (1982) found that prelingually deaf adults were judged to produce the most authentic signed ASL. In order to assure that the ASL passages were signed accurately, a prelingually deaf adult who was raised by deaf parents coached the interpreter as she signed the ASL stories on-camera. To further assure ease of comprehension and authenticity of both the signed English and the signed ASL passages, a team of three deaf adults viewed the videotape individually, correctly judged whether each passage was signed in English or ASL, and accurately recalled the propositions within each passage.

Each subject also completed two types of attitudinal scales, one rating how well the subjects liked each passage (preference rating), and another rating how difficult it was to understand each passage (comprehension rating).

Procedures. The subjects participated individually. After subjects had either read or viewed the first six passages, they were asked to recall everything they could remember about the six stories just encountered. Subjects were then asked to fill out each of the attitudinal rating sheets for the six stories just encountered and recalled. This same procedure for reading or viewing, recalling, and rating was repeated for the last six passages.

Results

The data are presented in reference to the following dependent variables: propositions recalled, reading times, preference ratings, and comprehension ratings. The alpha level for all tests of significance was set at .05.

Propositions recalled. In order to determine if there were significant differences in recall of propositions among the four language contexts, a two-factor within-subjects analysis of variance was performed, comparing the two levels of the mode factor (print and sign) and the two levels of the syntax factor (English and ASL).

The number of possible propositions to be recalled from each condition was 45. Table 1 shows the means and standard deviations. Results of the analysis of variance showed a significant main effect for the syntax factor, $F(1,29) = 6.43$, $MSe = 50.79$. No main effect, however, was found for mode, $F(1,29) = 2.39$, $MSe = 34.87$. Similarly, no mode-by-syntax interaction effect was found, $F(1,29) = 1.00$, $MSe = 20.75$. A post hoc examination of the results required only an inspection of the means for each condition. This analysis shows that more propositions were recalled from ASL than from English across the mode factor.

Reading times. Since the reading times were collected only from the print level of the mode factor across the two levels of the syntax factor, a dependent t-test was performed, comparing the reading times for print English and print ASL. A significant difference was found between the reading times ($t(29) = 4.27$), with print ASL requiring more reading time ($M = 127.21$, $SD = 31.87$) than print English ($M = 111.59$, $SD = 23.68$).

Preference ratings. In order to identify significant preference for any of the four contexts, a two-factor within-subjects analysis of variance was performed, comparing the two levels of the mode factor (print and sign) and the two levels of the syntax factor (English and ASL).

Table 1

Means and Standard Deviations for Dependent Measures

	Syntax			
	English		ASL	
Mode	M	SD	M	SD
	Propositions recalled			
Print	7.73	5.21	11.87	6.58
Sign	10.23	6.13	12.70	7.48
	Preference ratings			
Print	10.60	2.18	11.17	2.12
Sign	11.23	2.19	11.20	2.43
	Comprehensive ratings			
Print	12.57	1.98	11.77	2.57
Sign	12.50	2.29	12.30	2.30

N = 30

The means and standard deviations are presented in Table 1. The main effects for both mode and for syntax were not significant, $F(1,29) = 1.61$, $MSe = 2.07$ and $F(1,29) = 0.44$, $MSe = 4.81$, respectively. Similarly, there was no mode-by-syntax interaction effect, $F(1,29) = 0.81$, $MSe = 3.33$.

Comprehension ratings. Similar to the preference ratings, a two-factor within-subjects analysis of variance was performed on the comprehension ratings.

Table 1 presents the means and standard deviations. The main effect for mode was not significant, $F(1,29) = 0.52$, $MSe = 3.12$. Likewise, the main effect for syntax was not significant $F(1,29) = 1.20$, $MSe = 6.22$. There was no mode-by-syntax interaction effect, $F(1,20) = 0.89$, $MSe = 3.04$.

Discussion

Rather than reflecting an interaction between the mode and syntax components of each language context, the results showed that the number of propositions recalled from the ASL contexts was uniformly greater than the number recalled from the English contexts. Thus, the most influential component of the language contexts encountered by prelingually deaf high school students was syntax. Similarly, no interaction effects were found for the preference or comprehension ratings among the four language contexts. Given these results and the contextualist perspective on recall, considerable insight into how deaf individuals acquire meaningful information through the two language-syntax conditions within both the print and sign modes is provided by examining the most salient features of both ASL and English.

It is important to recall from earlier discussion that ASL is a visual and spatial language that is not formally taught to deaf children, but rather is acquired by association within the deaf adult community (Fant, 1972, 1977; Kretschmer & Kretschmer, 1978). The fact that the prelingually deaf high school students recalled propositions more easily when they were embedded within the ASL contexts, suggests that ASL triggers the application of familiar rules of a visual language system that are more effective in enhancing comprehension and recall than the predominant visual language of instruction (signed English). The roots of signed ASL are more likely to be established early in life for a child who derives meaning primarily through movement variations and other visual stimulation rather than through auditory input (Goldin-Meadow & Mylander, 1983). Although most prelingually deaf children (including the subjects of the present study) are educated in a system of signed English that attempts to integrate movement variations with the predominant language of the society, signed English does not appear to produce

the access to meaning that is available through the more "natural" context provided by ASL. The results of this research indicates that the continuous exposure to signed English in the educational setting does not necessarily facilitate the encoding or retrieval of meaningful propositions. Even though ASL is not the accepted language of instruction, the present study shows that the encoding and retrieval of information from ASL is superior to that retrieved from English in both sign and print modes.

The difference in reading time results between the Morariu and Bruning (1982) study and the present study may reflect the influence of a variation in research design, since the earlier study required that the subjects read all twelve passages in either ASL or English syntax (twice the number as in the present study). Some subjects from the present study, however, watched signed versions of six of the stories before they read the print versions of the remaining six passages.

The subjects' preference judgments and comprehension judgments raise an interesting question. No main effects or interaction effects were present; the subjects appear to have liked the stories equally well regardless of whether the stories required more or less reading time, or whether the subjects could recall greater or fewer propositions. Likewise, the subjects rated their comprehension approximately the same, irrespective of the effort involved in reading the print passages or watching the signed passages. As discussed in the introduction, however, the acquisition of English as the primary language is strongly encouraged among deaf learners at the expense of an early and formal acquisition of ASL. Why, then, would the deaf high school subjects of the present study rate ASL equal to English in both preference and comprehension?

These results suggest that even though English is encouraged as the proper language of communication, the processing of ASL, whether it is in sign or print,

is inherently accepted as just as appropriate a form of communication as English among this prelingually deaf population, irrespective of whether or not they are native users of ASL. A finding of no difference in preference is all the more remarkable given the social-demand characteristics that should bias these ratings toward the more acceptable preference of English. These individuals, then, are quite capable of encoding information from ASL-related language contexts even though they are encouraged to acquire print and signed English as their primary language.

Language context as described in this study appears to play a major role in facilitating in varying degrees the prelingually deaf individual's access to meaning. The fact that ASL provides a greater capacity for the encoding and retrieval of information than that of the typical language of instruction (English) suggests that ASL should be encouraged as the primary language of prelingually deaf individuals. Average six-year-old children with normal hearing have usually spoken and understood 80 to 90 percent of the basic sentence patterns that they will encounter as adults (Pearson & Johnson, 1978). Average prelingually deaf children, however, most often do not have the same advantage of being able to utilize the language tools necessary for exploring, experiencing, and questioning their environment during the early developmental years. The results of this study support in part the perspective that the roots of a visual information-processing system like ASL are already established by the time prelingually deaf children encounter signed or printed English contexts (Goldin-Meadow & Mylander, 1983). Providing prelingually deaf children with access to a comfortable, yet sophisticated, language like ASL as their primary language, then, may offer them the necessary tools for understanding the nature and utility of languages for the purposes of successful communication, thinking, and manipulation of the environment. Without such an early-established language base, the proven difficulties

that many prelingually deaf individuals experience in developing a sophisticated grasp of English may never be overcome.

A bilingual form of language instruction in which a strong language base of ASL is first established with the subsequent acquisition of English through the vehicle of ASL, may allow information-processing for prelingually deaf individuals to move beyond an educational focus on the syntactic concerns of English to a deeper semantic processing of the meaningful concepts embedded within both ASL and English contexts.

References

Bellugi, U., & Klima, E. (1975). Aspects of sign language and its structure. In J. F. Kavanagh & J. E. Cutting (Eds.), The role of speech in language. Cambridge, MA: The MIT Press.

Bellugi, U., Klima, E., & Siple, P. (1975). Remembering in signs. Cognition, 3, 93-125.

Bower, G. (1976). Experiments on story understanding and recall. Quarterly Journal of Experimental Psychology, 26, 511-534.

Conrad, R. (1972). Short-term memory in the deaf: A test for speech coding. British Journal of Psychology, 63(2), 173-180.

Fant, L. (1972). AMESLAN: An introduction to American Sign Language. Northridge, CA: Joyce Motion Picture Company.

Frumkin, B., & Anisfeld, M. (1977). Semantic and surface codes in the memory of deaf children. Cognitive Psychology, 9(4), 475-493.

Goldin-Meadow, S., & Mylander, C. (1983). Gestural communication in deaf children: Non-effect of parental input on language development. Science, 221, 372-374.

Hanson, V. (1982). Short-term recall by deaf signers of American Sign Language: Implications of encoding strategy for order recall. Journal of Experimental Psychology: Learning, Memory, and Cognition, 8, 572-583.

Hoemann, H. (1975). American Sign Language: Lexical and grammatical notes with translation exercises. Silver Spring, MD: National Association of the Deaf.

Hoffmeister, R. (1982, March). Educational implications of deaf signers' code switching ability. Paper presented at the American Educational Research Association Annual Meeting.

Kretschmer, R., & Kretschmer, L. (1978). Language development and intervention with the hearing-impaired. Baltimore: University Park Press.

Jenkins, J. (1974). Remember the old theory of memory? Well, forget it. American Psychologist, 29, 785-795.

LaBerge, D., & Samuels, S. (1976). Toward a theory of automatic information processing in reading. In H. Singer & R. Ruddell (Eds.), Theoretical models and processes of reading. Newark: International Reading Association.

Locke, J., & Locke, V. (1971). Deaf children's phonetic, visual, and dactylic coding in a grapheme recall task. Journal of Experimental Psychology, 89, 142-146.

MacDougall, J. (1979). The development of visual processing and short-term memory in deaf and hearing children. American Annals of the Deaf, 124(1), 16-22.

Morariu, J., & Bruning, R. (1982, March). Differential cognitive processing by deaf and hearing high school students using printed English and ASL passages. Paper presented at the American Educational Research Association Annual Meeting.

Pearson, P., & Johnson, D. (1978). Teaching reading comprehension. New York: Holt, Rinehart, & Winston.

Pepper, S. (1942). World hypotheses. Berkeley: University of California Press.

Shand, M. (1982). Sign-based short-term coding of American Sign Language signs and printed English words by congenitally deaf signers. Cognitive Psychology, 14, 1-12.

Siple, P., Fischer, S., & Bellugi, U. (1977). Memory for nonsemantic attributes of American Sign Language signs and English words. Journal of Verbal Learning and Verbal Behavior, 16, 561-574.

Treiman, R., & Hirsh-Pasek, K. (1983). Silent reading: Insights from second-generation deaf readers. Cognitive Psychology, 15, 39-65.

Wallace, G., & Corballis, M. (1973). Short-term memory and coding strategies in the deaf. Journal of Experimental Psychology, 99(3), 344-348.

Watkins, J., & Tulving, E. (1975). Episodic memory: When recognition fails. Journal of Experimental Psychology: General, 104(1), 5-29.

Working Paper presented

at the

International Symposium

on

Cognition, Education, and Deafness

Gallaudet College, Washington, DC, June 5-8, 1984